HABITAT CONDITIONS

Dam and Hydropower Influences

One water control structure, Dawt Mill Dam, is located on the mainstem of the North Fork River in Missouri. The dam is a low dam (less than 10 feet high) and is located 1.8 miles above Tecumseh. The original Dawt Mill Dam was constructed in late 1800s in order to supply power to the machinery of Dawt Mill (Cochran 1980 and Robins 1991d). Both the dam and mill were replaced shortly after the turn of the century. The dam was rebuilt again in the 1970s after flood debris severly damaged the dam (Cochran 1980). Other water control structures within the watershed in Missouri include Noblett Lake Dam (Noblett Creek), Rockbridge Dam (Spring Creek), and Althea Spring Dam (Althea Spring Branch). All were constructed prior to 1940. Figure Hc01 displays the location of the previously mentioned water control structures.

The North Fork River flows into Norfork Lake which has a recognized beginning at the confluence of Bryant Creek. Norfork Lake Dam was completed in 1944 and is located 4.8 river miles upstream from the confluence of the North Fork with the White River near Norfork, Arkansas (USACOE 1993). Norfork Lake Dam impounds 1,983,000 acre feet of water with a surface area of 30,700 acres at top of flood control pool.

Channel Alterations

There have been no significant channel alterations anywhere throughout the North Fork Watershed. Small channelization projects have probably occurred on private property and also from road and bridge construction. However, these activities currently are not considered to be a major threat to the river system. Currently (1999) there are no planned state transportation projects involving bridge construction within the watershed from 1999-2004(MDT 1999).

In 1998 there were 24 permitted gravel removal operations within the watershed (Figure Wq06) (USACOE 1998). The negative impacts of gravel mining have been shown to include channel deepening, sedimentation of downstream habitats, accelerated bank erosion, the formation of a wider and shallower channel, the lowering of the floodplain water table, and channel shift (Roell 1999).

Natural Features

Between 1987 and 1991 the Missouri Department of Conservation inventoried counties within the North Fork Watershed for unique natural features (Smith 1990; Ryan and Smith 1991). The inventories recognized seven categories of natural features: examples of undisturbed natural communities, habitat of rare or endangered species, habitat of relict species, outstanding geological formations, areas for nature studies, other unique features, and special aquatic areas having good water quality, flora, and fauna. These studies identified 177 potential natural features in the North Fork Watershed. Of the 177 sites, 124 had exceptional or highly significant natural features. The North Fork River and Bryant Creek were recognized as highly significant natural features. Roaring Spring, Hodgson Mill Spring, Althea Spring, Crystal Spring, Rockbridge (Morris) Spring, and Double Spring were recognized as highly significant spring sites.

Since the initial natural features inventory effort the Missouri Natural Heritage Database (NHD) has been created. The database lists many of the features which are included in the Missouri Natural Features

Inventory. The database, which is updated frequently, is a dynamic representation of the occurrence of many natural features in Missouri. Currently the database contains 294 features for the North Fork Watershed. These include 49 examples of 18 types of natural communities: The North Fork River, Bryant Creek, and Spring Creek are recognized as significant examples of Ozark creek and small river communities (MDC 1999c). Unique and outstanding dolomite bluffs, glades, and dry mesic chert forests are common throughout the watershed. Recorded occurrences of natural features currently (1999) in the NHD for the North Fork Watershed include

Caves-6

Creeks and Small Rivers (Ozark)-3

Dolomite Glade-10

Dry Chert Forest-1

Dry Limestone/Dolomite Cliff-1

Dry-Mesic Bottomland Forest-1

Dry-Mesic Chert Forest-3

Dry-Mesic Chert Prairie-1

Dry-Mesic Sandstone Forest-1

Fen-8

Fresh Water Marsh-1

Headwater Stream (Ozark)-1

Mesic Limestone/Dolomite Forest-1

Moist Limestone/Dolomite Cliff-3

Moist Sandstone Cliff-3

Pond Shrub Swamp-2

Prairie Fen-2

Shrub Swamp-1

A detailed description of these terrestrial natural communities can be found in The Terrestrial Natural Communities of Missouri by Nelson (1987), while a detailed description of Missouri's aquatic communities can be found in Aquatic Community Classification System for Missouri by Pflieger (1989)

Undoubtably more examples of natural features exist within the watershed. However due to many circumstances including the limited access to private land and the large land area, many features may be as yet unrecorded. Therefore, the previous listing of features should not be regarded as final. However, this listing does provide a good cross section of the types of communities which can be found within the watershed.

Improvement Projects

There are currently (1998) 3 DSP-3 projects within the North Fork Watershed. These are intensive rotational grazing programs sponsored by the Natural Resource Conservation Service (NRCS) and involve alternative watering systems. All are in progress. There are 3 completed Landowner Cooperative Projects including a cedar tree revetment project completed in cooperation with the United States Forest Service and located at the North Fork Recreation Area. One other project is currently awaiting landowner approval (Pratt personal communication 1998). Table Hc01 lists all stream related projects in the watershed.

Stream Habitat Assessment

In 1996 and 1998, stream and riparian habitat quality were evaluated at 13 sites within the North Fork Watershed. Of the 13 sites, 6 were located in the Bryant Creek Subwatershed, 6 in the North Fork Watershed above the Bryant Creek confluence, and 1 in the Norfork Lake and Tributaries Subwatershed. These sites generally corresponded to 1996 fish community sample sites. Habitat quality was assessed using the MDC Stream Habitat Annotation Device (SHAD II). Selected SHAD data was entered into a geographic information system (GIS) database based on a numerical system which enabled more efficient analysis of data. Sites were evaluated based on the following SHAD categories: "streambank erosion", "streambank erosion protection", "percent timbered stream corridor", and "narrowest width of timbered corridor". Numerical values associated with different levels of condition for each category were then assigned to left and right streambanks and corridors evaluated with 1 being extremely poor and 5 being excellent. These values were then averaged to give an overall grade for the site (Figure Hc02). The lowest grade within the North Fork Watershed was a 3 (fair). Three sites received this rating. Five sites were rated as 5 (excellent). The remaining five sites were rated as good.

There appears to be no significant distribution pattern of SHAD sites relative to grade. This illustrates the complications of using SHAD data as a means for determining watershed and even subwatershed habitat condition. Depending on site selection methodology as well as the level of homogeny of habitat within a watershed, the SHAD can be a very site specific method of habitat evaluation. Thus, in most cases, the more broadly that SHAD data is applied to a watershed, the less accurate it becomes.

Perhaps one of the more difficult attributes of a watershed to attempt to quantify is stream habitat. This is due to the fact that there are several dynamic characteristics which make up stream habitat. To evaluate all of these characteristics individually and accurately for an entire watershed is a monumental task and beyond the scope of this document. Thus, the next best thing is to evaluate a characteristic that has the most impact on all aspects of stream habitat. This is, arguably, riparian corridor land cover/land use. Riparian corridor land cover effects many aspects of stream habitat. These include, but are not limited to water temperature, turbidity, nutrient loading, sand/gravel deposition, instream cover, flow, channel width, and channel stability. These in turn have effects on still other characteristics of stream habitat such as food availability, dissolved oxygen, cover, spawning areas, etc.

Evaluation of riparian corridor land cover/land use within the North Fork Watershed was accomplished using Missouri Resource Assessment Partnership Phase 1 Land Cover Data(morapmd.wpd). A buffer zone 3 pixels (90 meters) wide was created which corresponded to a 1:100,000 hydrography coverage for the watershed. This was split into segments no longer than 0.25 miles long (Caldwell, personal communication). Percent land use for each segment was then calculated. Land cover/land use categories included forest, woodland, grassland, cropland, urban, and water. Percentages of these categories were

then calculated for riparian corridors within each of the 30 fourteen digit hydrologic units, the 6 eleven digit hydrologic units within the watershed, as well as the whole watershed.

Results for the entire watershed indicate that riparian corridor land use consists of more forest/woodland (64.9%) than grassland/cropland (34.2%). Combined percentages for the remaining categories are less than 1% of the total riparian corridor land cover/land use in the watershed. Of the 6 eleven digit hydrologic units (HUs) within the watershed, the Upper North Fork HU has the highest combined percentage of forest/woodland corridor land cover/land use at 71.2%. It also has the lowest combined percentage of grassland/cropland corridor land use at 28.3%. This is due in large part to the fact that much of this section is part of the Mark Twain National Forest. Table Hc02 gives riparian corridor land cover/land use percentages for all fourteen digit hydrologic units within the watershed as well as percentages for the three major drainage sections of the watershed and the total watershed. Figure Hc03 presents a graphic representation of riparian corridor land cover/land use for all fourteen digit hydrologic units within the watershed.

An aerial stream survey of the North Fork River Watershed was made during March and April, 1996. The survey flight covered the entire length of the North Fork, Bryant Creek, and many other major tributaries. A catalog of the flight, highlighting stream and riparian destabilization areas and other significant landmarks has been completed. Highway and topographic maps have been labeled according to the video index time. The catalogs also include an index of slides taken during the flight. Information from this survey will be useful for a variety of projects such as future habitat assessment, assisting landowners with problems associated with stream bank erosion and deposition, reviewing gravel mining permits, selection of aquatic biota sampling sites, etc.

Cold Water Habitat

Approximately 39 miles of stream within the North Fork Watershed are designated for cold-water sport fishery (Figure Hc04)(MDNR 1996a). Approximately 14 miles of the North Fork River are designated for cold-water sport fishery. Table Hc03 lists additional stream segments designated for cold-water sport fishery.

In an effort to further quantify cold water resources within the North Fork Watershed, instantaneous stream temperatures were recorded at many stream crossings within the watershed during August of 1991, 1992, 1993, and 1994. Results from this preliminary study were then used to determine sites for placement of thermographs (long term temperature recorders). These were placed at 47 selected sites in the summer of 1995 and 1996 (Table Hc04). Thermographs were programmed to record temperatures every 2 hours. Period of record for the thermographs varied from 12-64 days. Average stream temperature at each site for period of record was determined and then compared to average air temperature (Mountain Grove) for period of record (Figure Hc04). Figure Hc05 displays results of comparisons of average stream temperature and average air temperature for sites exhibiting an average air temperature of 80 degrees Fahrenheit or higher. The higher average air temperature at these sites enables a more confident determination of spring influenced sites. Figure Hc06 shows the comparison of temperature graphs between air temperature, a spring influenced site, and a non-spring influenced site. The limited period of record for some thermograph sites as well as a relatively mild summer in 1996 limits the use of some of this data. Results of comparisons between sites with different periods of record are questionable. Furthermore, sites with shorter periods of record or periods which occur later in the summer typically exhibit cooler average air temperatures and thus a smaller gradient between the average

air and average stream temperature. Additional temperature study will be required in order to further determine spring influence within the watershed.

Figure Hc01.

North Fork Watershed

Dams

4 0 4 8 Miles

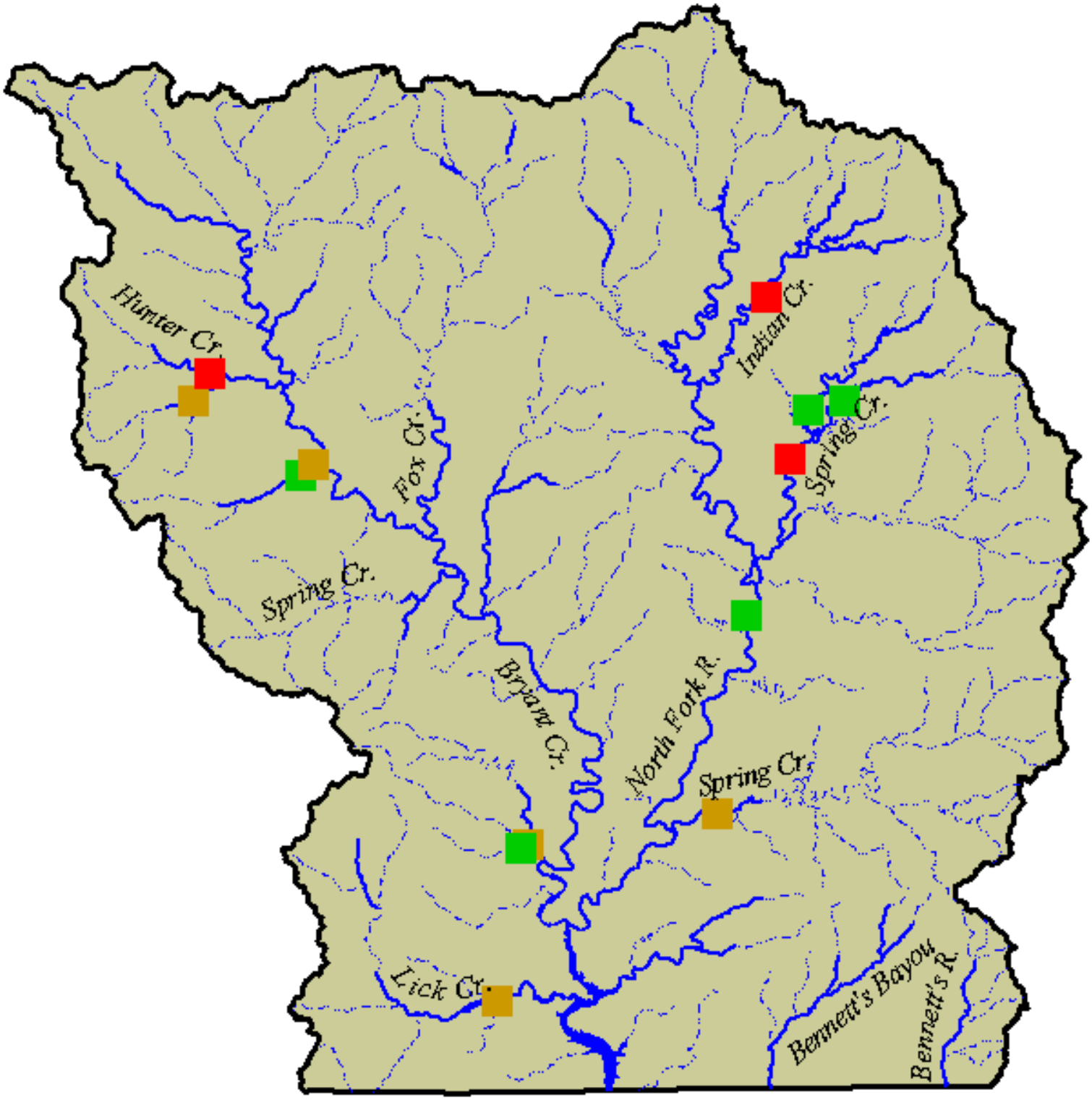
Site

N

1 Dawt Mill Dam
2 Noblett Lake Dam
3 Althea Spring Branch Dam
4 Rock Bridge Dam
* Does not include earthen dams

Figure Hc02.

North Fork Watershed
Stream Habitat Assessment

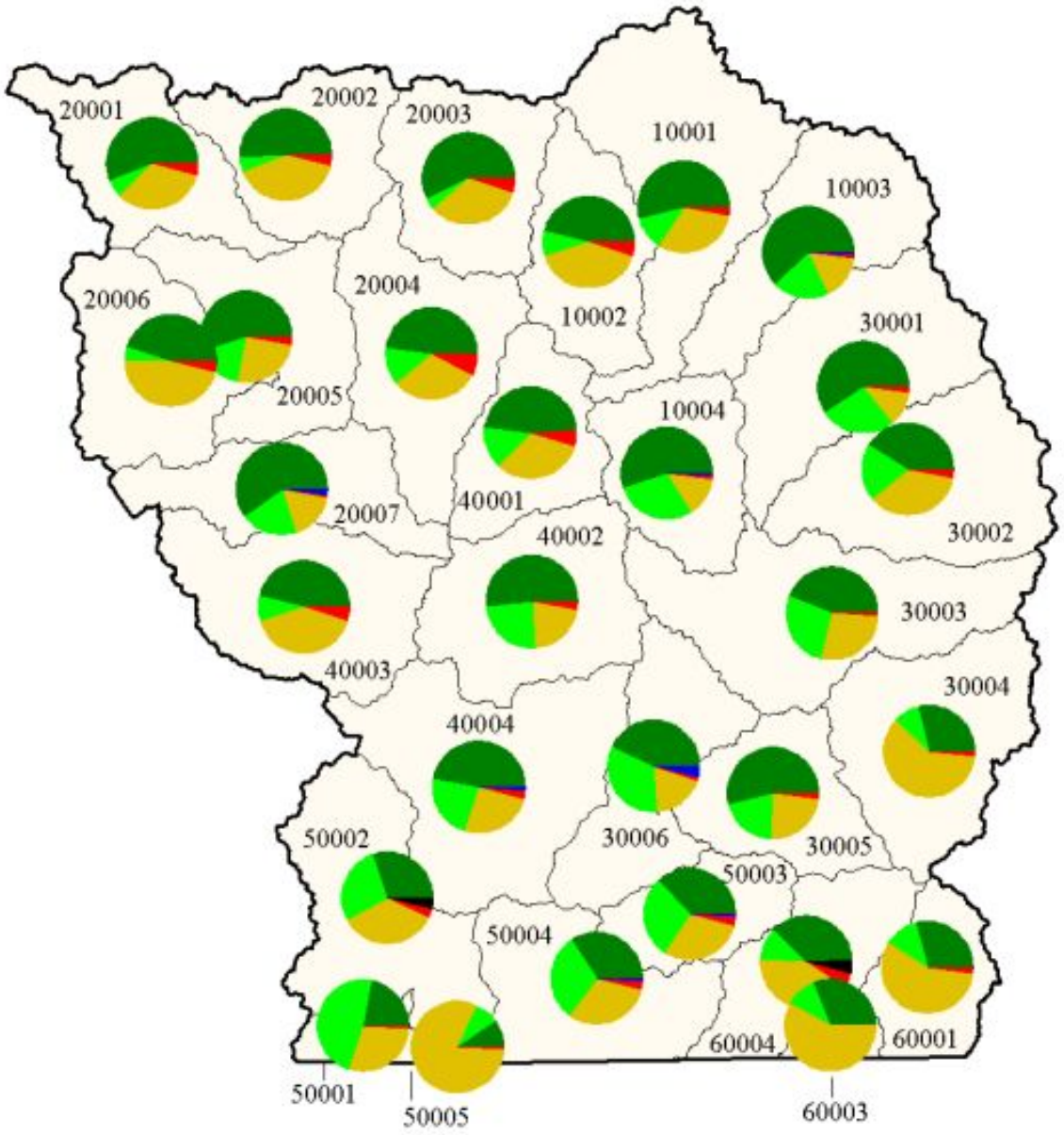



Legend
S.H.A.D. Sites
Excellent
Good
Fair

Figure Hc03.

North Fork Watershed

14 Digit Hydrologic Unit Riparian Corridor Land Cover/Land Use



4 0 4 8 Miles

Legend

Percent Riparian Corridor Land Cover/Land Use*

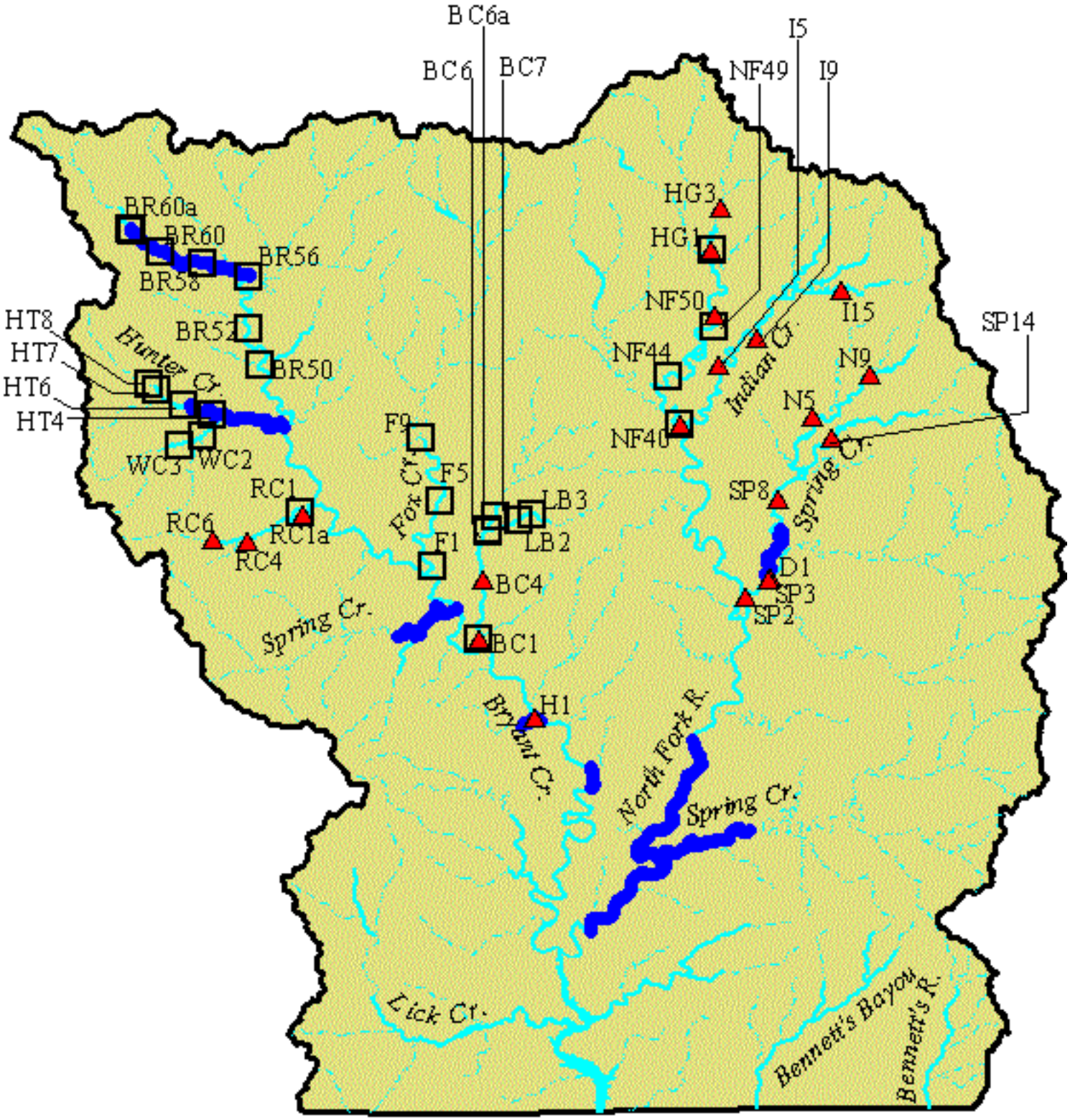
- Forest
- Woodland
- Grassland
- Cropland
- Urban
- Water

*Based on Missouri Resource Assessment Partnership (MoRAP) Phase 1 Land Cover Data.

N

Figure Hc04.

North Fork Watershed
Thermograph Sites



4 0 4 Miles

N

Legend

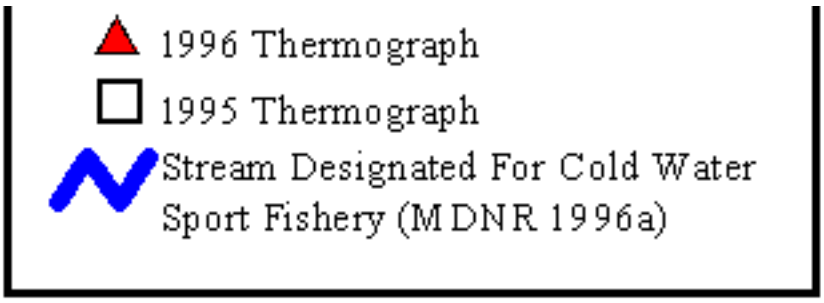

1996 Thermograph
1995 Thermograph
Stream Designated For Cold Water Sport Fishery (MDNR 1996a)

Figure Hc05. Comparison of 1995 average air temperature (Moutain Grove) and average stream temperature for selected sites within the North Fork Watershed.

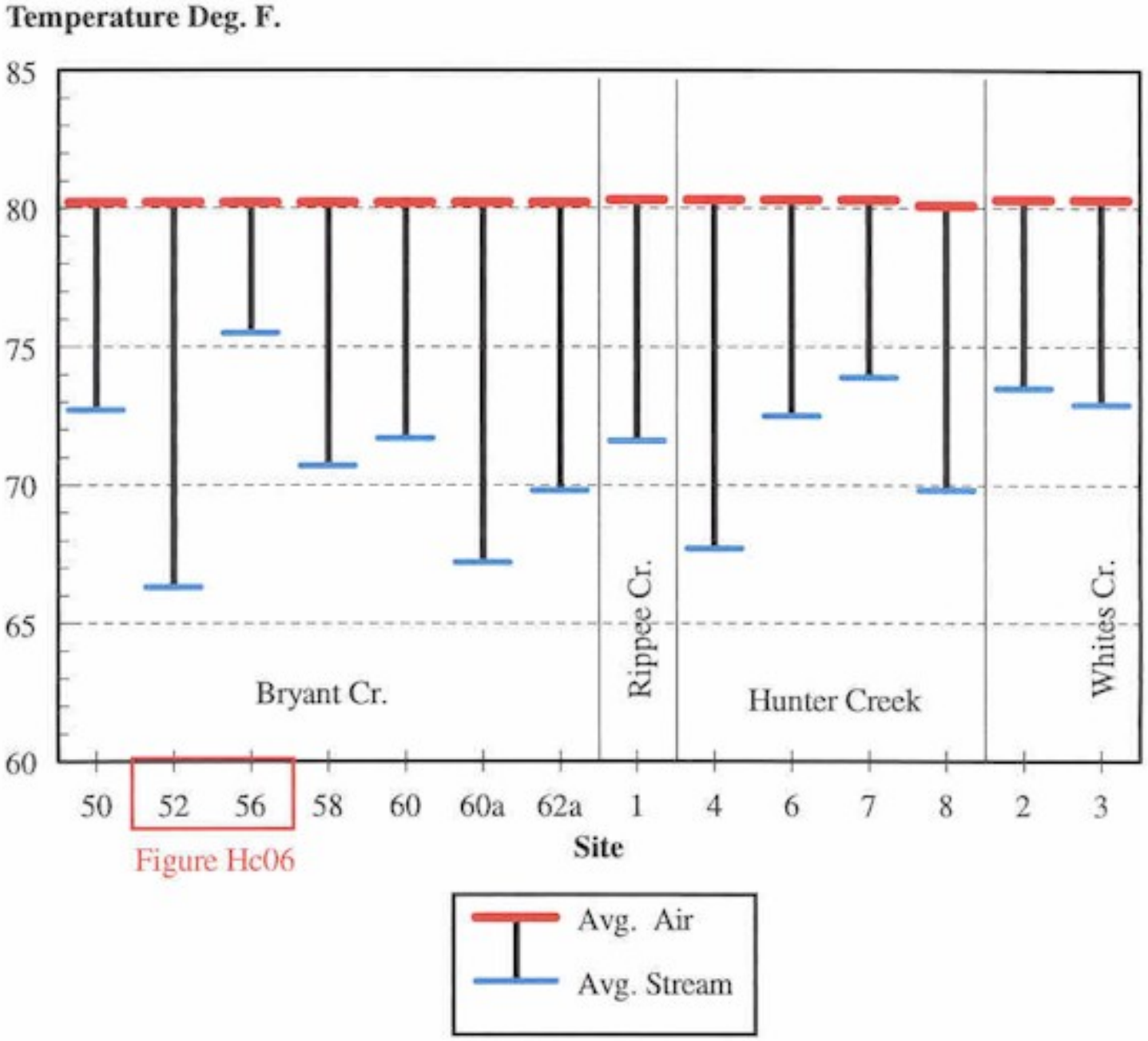


Figure Hc06

Figure Hc06. Comparison of 1995 air temperature (Moutain Grove) to site 52, exhibiting a substantial spring influence, and site 56 which does not exhibit a subtantial spring influence.

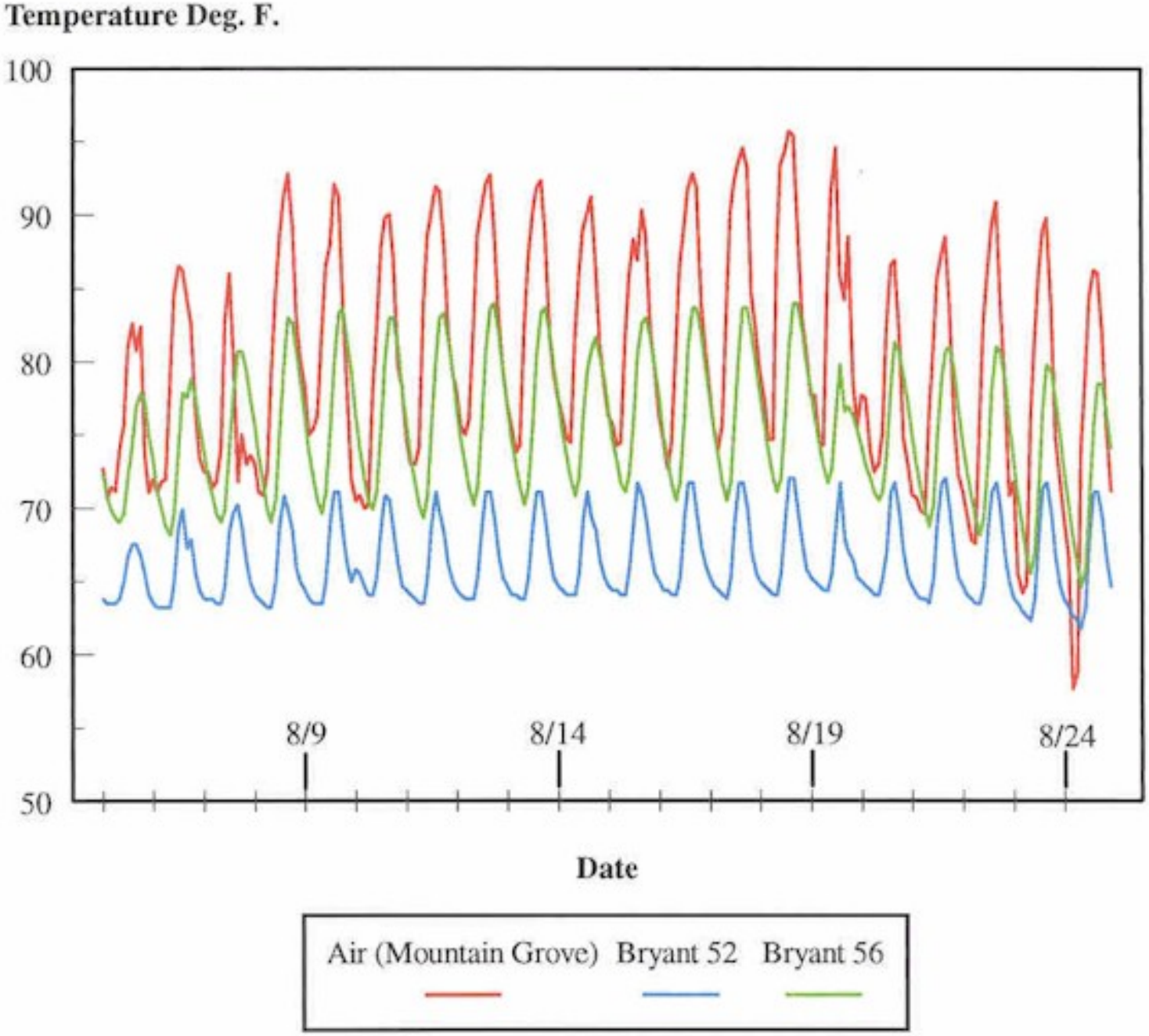


Table Hc01. Missouri Department of Conservation stream improvement projects within the North Fork River Watershed. (Pratt, personal communication)

Affected Stream	Project Type	Completion Date
Bryant Cr.	Cedar Tree Revetment	May, 1997
Bryant Cr.	Willow/Sycamore Pole Stabilization	winter/spring 1998
Spring Cr.	In-Stream Habitat Improvement	winter/spring 1998
Bennett's Bayou	Alternative Watering System	winter/spring 1998
S. Bridges Cr.	Alternative Watering System	winter/spring 1998
Lick Cr.	Willow/Sycamore Pole Stabilization	winter/spring 1998
North Fork R.	Alternative Watering System	summer 1998
North Fork R.*	Cedar Tree Revetment	summer 1994

*In cooperation with the United States Forest Service.

Table Hc02. Percent riparian corridor land use for 14 digit and 11digit (bold) hydrologic units within the North Fork Watershed. Data is based on MORAP Phase 1 Land Cover (1997) as analyzed by Caldwell (1998).

Subwatershed	FOR	WDL	GRS	CRP	URB	WAT
10001	54.2	11.7	30.5	3.2	0	0.4
10002	46.3	8.6	40.2	4.7	0	0.2
10003	62.5	19.7	16.0	1.4	0	0.4
10004	55.1	28.6	13.6	1.3	0	1.4
Upper North Fork	**55.1**	**16.1**	**25.6**	**2.7**	**0**	**0.5**
20001	56.2	5.7	34.3	3.6	0.1	0.1
20002	50.8	5.2	39.6	4.0	0.4	<0.1
20003	56.7	4.2	33.9	5.3	0	<0.1
20004	47.7	12.9	31.1	8.1	0	0.1
20005	54.6	17.3	24.6	3.3	0	0.2
20006	45.4	4.9	46.0	3.6	0	<0.1
20007	60.0	20.7	17.1	1.3	0	0.9
Upper Bryant	**53.0**	**10.0**	**32.4**	**4.3**	**<0.1**	**0.2**
30001	58.8	27.2	11.6	1.8	0	0.6
30002	40.8	20.4	35.5	3.3	0	<0.1
30003	43.5	26.5	27.9	1.3	0	0.8
30004	28.7	8.5	60.1	2.4	0	0.3
30005	54.2	19.5	24.4	1.8	0	0.1
30006	42.9	33.0	18.6	0.8	0	4.7
Lower North Fork	**44.6**	**22.3**	**30.2**	**1.9**	**0**	**0.9**

40001	47.7	14.8	31.7	5.7	0	0.2
40002	51.6	24.2	20.8	2.5	0	0.9
40003	45.5	9.3	40.1	4.7	0	0.3

FOR =Forest, **WDL**=Woodland, **GRS**=Grassland, **CRP**=Cropland, **URB**=Urban, **WAT**=Water

Table Hc02. Percent riparian corridor land use for 14 digit and 11digit (bold) hydrologic (continued) units within the North Fork Watershed. Data is based on MORAP Phase 1 Land Cover (1997) as analyzed by Caldwell (1998).

Subwatershed	FOR	WDL	GRS	CRP	URB	WAT
40004	46.7	22.7	26.2	2.9	0	1.6
Lower Bryant	**47.6**	**18.3**	**29.6**	**3.7**	**0**	**0.9**
50001	21.7	48.2	28.7	1.5	0	0
50002	30.3	28.0	35.1	2.7	3.8	<0.1
50003	37.4	29.1	29.8	3.1	0	0.6
50004	34.1	30.5	30.8	3.4	0	1.2
50005	11.4	8.1	79.4	1.1	0	0
West Norfork Lake	**31.5**	**30.7**	**32.7**	**2.8**	**1.7**	**0.4**
60001	29.1	12.2	57.1	1.6	0	0
60003	31.0	11.0	57.9	0	0	0
60004	37.7	11.1	42.0	4.5	4.7	<0.1
East Norfork Lake	**32.7**	**11.0**	**46.9**	**2.9**	**2.5**	**<0.1**
North Fork Watershed	**47.1**	**17.8**	**31.1**	**3.1**	**0.3**	**0.6**

FOR =Forest, **WDL**=Woodland, **GRS**=Grassland, **CRP**=Cropland, **URB**=Urban, **WAT**=Water

Table Hc03. Streams designated for cold-water sport fishery within the North Fork Watershed by MDNR (1996a). Location given in section, township and range format.

Stream Name	Miles	From	To	County
Bryant Creek	1	3,23N,12W	34,24N,12W	Ozark
Bryant Creek	6	19,27N,14W	8,27N,15W	Douglas
Hunter Creek	5	22,26N,15W	20,26N,15W	Douglas
Hurricane Creek	1.5	Mouth	30,24N,12W	Ozark
North Fork River	13.5	3,22N,12W	28,24N,11W	Ozark
Spring Creek (Bryant)	3	Mouth	5,24N,13W	Douglas-Ozark
Spring Creek (North)	2.5	Mouth	26,25N,11W	Douglas
Spring Creek (South)	5	Mouth	14,23N,11W	Ozark
Turkey Creek	1	Mouth	17,23N,15W	Ozark

Table Hc04. Average stream temperature (deg. Fahrenheit) and air temperature (Mountain Grove) for thermograph Sites within the North Fork Watershed. Average stream temperature is based on observations every 2 hours. Average air temperature is based on observations every hour.

Site	Stream	In Date	Out Date	n	Avg. Stream Temp.	Avg. Air Temp.
BC1	**Brush Cr.**	19950830	19950912	168	70.0	70.6
BC6	**Brush Cr.**	19950830	19950912	168	65.8	70.6
BC6a	**Brush Cr.**	19950830	19950912	168	63.9	70.6
BC7	**Brush Cr.**	19950830	19950912	168	69.1	70.6
BC1	**Brush Cr.**	19960718	19960910	660	72.8	73.6
BC4	**Brush Cr.**	19960717	19960910	660	71.9	73.6
BR50	**Bryant Cr.**	19950805	19950824	240	72.7	80.2
BR52	**Bryant Cr.**	19950805	19950824	240	66.3	80.2
BR56	**Bryant Cr.**	19950805	19950824	240	75.5	80.2
BR58	**Bryant Cr.**	19950805	19950824	240	70.7	80.2
BR60	**Bryant Cr.**	19950805	19950824	240	71.7	80.2
BR60a	**Bryant Cr.**	19950805	19950824	240	67.2	80.2
BR62a	**Bryant Cr.**	19950805	19950824	240	69.8	80.2
D1	**Dry Cr.**	19960724	19960909	576	67.1	72.9
F1	**Fox Cr.**	19950903	19950914	144	70.1	68.3
F5	**Fox Cr.**	19950903	19950914	144	68.8	68.3
F9	**Fox Cr.**	19950903	19950914	144	64.6	68.3
H1	**Hurricane Cr.**	19960718	19960919	768	64.9	71.9
HG1	**Hungry Cr.**	19950903	19950914	144	63.8	68.3
HG1	**Hungry Cr.**	19960701	19960910	492	68.1	73.2
HG3	**Hungry Cr.**	19960701	19960910	492	68.0	73.2

HT6	**Hunter Cr.**	19950806	19950827	264	72.5	80.3
HT7	**Hunter Cr.**	19950806	19950827	264	73.9	80.3
HT4	**Hunter Cr.**	19950806	19950827	264	67.7	80.3

n=number of stream temperature observations for period of record.

Table Hc04. Average stream temperature (deg. Fahrenheit) and air temperature (Mountain (continued) Grove) for thermograph Sites within the North Fork Watershed. Average stream temperature is based on observations every 2 hours. Average air temperature is based on observation every hour.

Site	Stream	In Date	Out Date	n	Avg. Stream Temp.	Avg. Air Temp.
I15	**Indian Cr.**	19960726	19960918	660	70.8	71.1
I5	**Indian Cr.**	19960726	19960919	672	64.5	70.9
I9	**Indian Cr.**	19960726	19960918	660	72.3	71.1
LB2	**L. Brush Cr.**	19950830	19950911	156	65.9	70.5
LB3	**L. Brush Cr.**	19950830	19950911	156	67.3	70.5
N5	**Noblett Cr.**	19960724	19960909	576	71.4	72.9
N9	**Noblett Cr.**	19960724	19960918	684	69.3	71.2
NF40	**North Fork R.**	19950903	19950914	144	67.6	68.3
NF44	**North Fork R.**	19950903	19950914	144	65.8	68.3
NF49	**North Fork R.**	19950903	19950914	144	69.6	68.3
NF40	**North Fork R.**	19960701	19960910	492	71.5	73.2
NF50	**North Fork R.**	19960701	19960910	492	73.3	73.2
RC1a	**Rippee Cr.**	19950806	19950827	264	71.6	80.3
RC1	**Rippee Cr.**	19960717	19960910	672	69.5	73.8
RC4	**Rippee Cr.**	19960717	19960910	672	67.8	73.8

RC6	**Rippee Cr.**	19960717	19960910	672	70.3	73.8
SP14	**Spring Cr.**	19960724	19960918	684	68.4	71.2
SP2	**Spring Cr.**	19960724	19960909	588	67.0	72.9
BS1	**Big Spring Br.**	19960724	19960909	588	74.6	72.9
SP8	**Spring Cr.**	19960724	19960909	588	67.0	72.9
TC	**Turkey Cr.**	19950805	19950827	264	69.8	80.1
WC2	**Whites Cr.**	19950806	19950827	264	73.5	80.3
WC3	**Whites Cr.**	19950806	19950827	264	72.9	80.3

n=number of stream temperature observations for period of record.